

REMARKS

The Examiner's Office Action of December 29, 2003 has been received and its contents reviewed. The Examiner is thanked for the review and consideration of the present application.

By the above actions, claim 1 has been amended to improve form and claims 9-12 have been cancelled. Thus, claims 1, 2, 4-8, 31 and 32 are pending, claims 13-30 are withdrawn and claims 3 and 9-12 have been cancelled. Support for the amendments to independent claim 1 can be found, for example, on page 27, line 24 to page 28, line 6 of the specification. Accordingly, Applicants respectfully submit that no new matter has been added by the foregoing amendment.

Referring now to page 2 of the detailed Office Action, claims 1, 2, 4, 9-12 and 32 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 4,915,777 to Jucha et al. (hereinafter "Jucha") in view of U.S. Patent Publication No. 2001/0048980 to Kishimoto et al. (hereinafter "Kishimoto"), claims 5, 7 and 8 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Jucha in view of Kishimoto, further in view of U.S. Patent No. 4,442,591 to Haken, and claims 6 and 31 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Jucha in view of Kishimoto, further in view of U.S. Patent No. 5,943,565 to Ju. In view of the amendments above and the comments provided below, Applicants respectfully traverse these rejections.

The presently claimed invention is directed to a method of forming an insulating film on a semiconductor layer, comprising the steps of: (a) loading a substrate including said semiconductor layer on a lower electrode in a processing chamber, and (b) generating, within the processing chamber, plasma biased toward said substrate by introducing only oxygen into the processing chamber and with the substrate heated to a temperature of up to 300°C, thereafter subjecting said semiconductor layer to the biased plasma, wherein an exposed surface of the semiconductor layer on the substrate is oxidized by the biased plasma in the step (b). With regard to the presently claimed invention, the surface of the semiconductor layer is oxidized by the biased oxygen plasma at a temperature of up to 300°C, so as to form an insulating film. When compared with thermal oxidization, the insulating film made in accordance with the present invention can be formed at a lower temperature and, as a result,

problems such as the deterioration of characteristics of the substrate due to high temperature can be avoided.

The Jucha patent, on the other hand, discloses a process in which a thin film of tungsten is anisotropically etched under plasma bombardment conditions (see abstract). Specifically, silane and oxygen are introduced into a process chamber 218 into which wafer 48 is placed. The chamber is then irradiated with ultraviolet light to react oxygen and silane (silicon), and silicon dioxide is deposited on the wafer (see column 26, lines 20-40).

In the most recent Office Action the rejection points out that N_2O or O_2 is introduced into the chamber 254 to produce a remote plasma and column 26, lines 25-28, is referenced. However, Applicants respectfully submit that, reading further in column 26, in addition to the referenced oxygen source (such as N_2O or O_2), a silicon source such as silane or disilane, and ozone are also introduced into the process chamber 218 in which a silicon dioxide film is formed on the wafer 48. In the presently claimed invention, on the other hand, only oxygen is introduced into the processing chamber, and the surface of the semiconductor layer is oxidized by the biased oxygen plasma. Applicants submit that Jucha fails to disclose that only oxygen is introduced into the processing chamber and that the surface of the semiconductor layer is oxidized by the biased oxygen plasma.

Applicants further submit that none of the other references provided in support of Jucha appear to solve this deficiency in the Jucha patent. For example, the Kishimoto patent discloses that a silicon dioxide film is formed by a high density plasma enhanced chemical vapor deposition method using silane, oxygen and argon gases (see paragraph [0097] for example). Further, the Haken patent discloses a high-voltage CMOS process in which a gate oxide film is formed by oxidization and there is no disclosure or suggestion of oxidizing a semiconductor layer using a biased plasma. Additionally, the Ju patent is directed to a method of manufacturing a CMOS semiconductor device having independently optimized transistor performance (see column 1, lines 6-8). Accordingly, Applicants submit that none of Kishimoto, Haken or Ju teach or suggest generating, within the processing chamber, plasma biased toward said substrate by introducing only oxygen into the processing chamber as now recited in independent claim 1.

In view of the arguments set forth above, Applicants respectfully request reconsideration and withdrawal of all the pending rejections.

While the present application is now believed to be in condition for allowance, should the Examiner find some issue to remain unresolved, or should any new issues arise which could be eliminated through discussions with Applicants' representative, then the Examiner is invited to contact the undersigned by telephone in order that the further prosecution of this application can thereby be expedited.

Respectfully submitted,



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